

Raising Young Pupils and Students' Awareness Levels About the Impacts of Digital Technologies on the Environment, Climate, Health and Well-Being Through a Challenge

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Abstract—Digital technologies are everywhere, and everyone is using them and interacting with them in everyday life. However, not everyone is aware of the impacts that their usage does have on the environment, the climate, their health and well-being, should they be positive or negative.

This work-in-progress paper presents how a quiz-based challenge has been designed for young pupils from secondary schools and students in higher education to raise their own awareness about these impacts. More precisely, this paper presents how the challenge has been defined, including young students in engineering in the team. It also details its structure and how the questions set has been designed.

The paper then presents preliminary results obtained from the analysis of data collected during a first edition of the proposed challenge, run in November 2022 in the French-speaking part of Belgium. The analysis highlights that negative impacts are better known than positive ones. It also reveals that questions related to energy and CO₂ emissions are the best-known. Analysing the profiles of the participants also showed that a large majority are paying attention to their digital consumption and would be ready to adapt their behaviour to reduce their negative impacts.

The paper concludes with a discussion about how the challenge could be used in engineering schools, as an introduction to courses related to the development of digital technologies, to make students future responsible developers.

Index Terms—Environment, Digital technologies, Challenge

I. INTRODUCTION

Nowadays, digital technologies have become part of everyday life. Everyone is supposed to use them and interact with them in everyday life. On one side, digital technologies do bring some benefits to the society, particularly in terms of efficiency, faster access to information, better information processing, etc. On the other side, they also have negative impacts, should it be from the production of the devices, their usage or the management of their end of life. These negative impacts may be on the environment [1]–[3], the climate [4], [5], the health [6], [7] and the well-being [8]. Another issue with digital technologies is the digital divide which makes it difficult or even impossible for some people to access services based on them [9], [10]. It is important for people to be aware of these impacts, for them to use digital technologies

in the most responsible and sustainable way possible. On the other side, there are also positive impacts that can be brought by digital technologies, such as for the development of adolescents [11] or to tackle environmental challenges, for example in developing countries [12]. Digital technologies are usually considered to be both part of the problem and the solution [13] and it is therefore important to focus on both kinds of impacts.

To contribute increasing the awareness of people about both the positive and negative impacts of the digital work, this work-in-progress paper presents how a quiz-based challenge has been designed. Its main target are young pupils from secondary schools and students in higher education.

A. Motivation

Very few people are aware of the negative impacts of the usage of digital technologies even if they are heavily using them. One possible explanation is that what supports these technologies is mostly hidden. The term “*dark side of the internet*” is often used to refer to this hidden face [14]. One solution to overcome these negative impacts is, of course, to develop better technologies. This is being investigated and usually referred to as the “*green IT*” movement.

The DigiScope project, funded by the European Union as part of the Mindchangers project, aims at making aware young people on the impacts of digital technologies, mainly on the environment and the climate. The challenge presented in this paper is one of the activity designed as part of the DigiScope project. Its main motivation was to find a way to reach as many people as possible, to confront them in a fun way to the impacts of digital technologies. Challenges are a motivating way to introduce people to a given topic, in particular when this latter is less known [15], [16]. They may also be a fruitful way to raise awareness about climate change while promoting a positive engagement [17].

B. Research Question

This work-in-progress paper is about how the first edition of the challenge has been organised. It presents some preliminary results about the current level of awareness of young people about the impacts of digital technologies. The research question addressed by this paper is precisely about this awareness level. This piece of research is part of a broader research being conducted about how to increase this level of awareness and about how efficient a challenge can be to do so.

After this introduction, the paper is structured as follows. Section II presents the challenge and how it has been designed. Section III details the results obtained from the first run of the challenge. Section IV then discusses the results in the light of the research questions addressed in this paper. Finally, the last section concludes with a presentation of future work.

II. CHALLENGE

A challenge has been designed to raise people's awareness about the positive and negative impacts of digital technologies on the environment, climate, health and well-being. It has been co-created with youthful students in engineering from the *Louvain School of Engineering* as a two-round event. It was organised at the end of the year 2022 for the French community in Belgium, as a part of the DigiScope project.

A. Challenge Structure

The proposed challenge consists in a quiz with multiple choices questions. The first round is an online playoff that spreads over six weeks. As summarised in Table I, participants had to respond to 18 questions with various levels of difficulty (ten easy questions, five medium and three hard) within at most 15 minutes. For each correct answer, they obtain a number of points depending on the difficulty level (one point for easy questions, two for medium ones and three for hard ones). An incorrect answer results in the retraction of one point, and abstentions have no effect. Therefore, the final score of each participant ranges between -18 and 29 . Questions proposed were selected at random from a set with a total of fifty questions (23 easy questions, 18 medium and 9 hard ones).

TABLE I: In the online playoff round, contestants have to answer 18 questions with a well-defined grading scheme.

	Easy	Medium	Hard
Questions set size	23	18	9
Number of questions asked	10	5	3
Grade for...			
correct answer	1	2	3
wrong answer	-1	-1	-1
abstention	0	0	0

Contestants were split into three categories: secondary school pupils (12–18 years old), higher education students and public at large. The fifteen best contestants of each category have been invited to the second round of the challenge. This final round again consists in a quiz with multiple choices questions, with various levels of difficulty, that have to be answered in a given maximum amount of time. It takes place during an on-site event, ending with an award ceremony.

B. Questions Set Design

The questions used for the challenge are multiple choices ones. They have been designed by a jury composed of eight young students in engineering from the *Louvain School of Engineering*, seven young professionals working in ICT-related companies and three computer science professors. For the playoff round, the jury was asked to mainly produce questions whose answer options are figures related to impacts of digital technologies on the environment, the climate, the health or the well-being, should they be positive or negative. For example, question #22 of the set is: “*What share do digital technologies play in global greenhouse gas emissions?*”, with the following four answer options: A) 0.20%, B) 1%, C) 4%, D) 10%. For the final round, the focus has been placed on questions whose answer options are not figure. For example, question #1 of the set is: “*In which phase of the life cycle of an electronic device do we produce the most waste?*”, with the following four answer options: A) manufacturing, B) use, C) recycling, D) the three phases produce a similar amount of waste.

III. RESULTS

A first edition of the challenge has been run in the French-speaking part of Belgium in 2022. The playoff round ran from October 3 to November 13, 2022. It managed to engage 135 contestants who fully took part, while about 20 persons abandoned after having answered a few questions. The final round took place on November 23, 2022, and only 23 persons showed up of the 45 invited finalists.

A. Profile and Background

Figure 1 shows how contestants are divided by categories, genre and age groups for the playoff round. The distribution by categories is quite uniform, and a little more females took part compared to males. Regarding the age groups, the number of younger participants was higher, which is logical since they represented the principal target of the DigiScope project for which the challenge was organised. Finally, the geographic distribution among the French-speaking part of Belgium, not shown on this figure, was reasonably uniform, except for the Brussels area from where there were fewer contestants.

TABLE II: The results of a survey conducted on the participants show that they are willing to adapt their behaviour to decrease the negative impacts due to their usage of IT.

	Yes	No	Partly
Q1: Do you usually pay attention to your digital consumption?	44	78	n/a
Q2: Have you ever attended workshops, conferences, training or events on sustainable IT?	19	100	n/a
Q3: Would you be ready to adapt your digital behaviour to reduce the negative impacts?	70	5	46

To better understand the interest of the participants to take part in the challenge, three optional questions were proposed to them upon registration. From the 135 contestants, only 122 of them either fully or partially returned the survey. The results reported on Table II show that the majority of the contestants

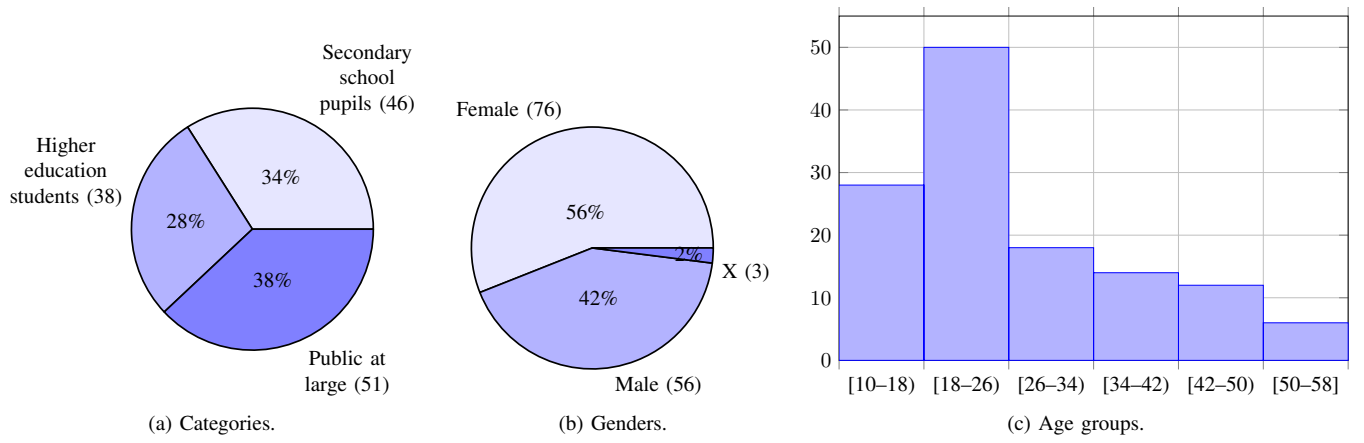


Fig. 1: Several statistics have been collected about the profile of the contestants who participated to the playoff round.

of the playoff round does not pay attention to their digital consumption and has never taken part in any event related to sustainable IT. Moreover, most of them would agree to adapt their behaviour to decrease the negative impacts they induce due to their usage of digital technologies.

Analysing the answers to the survey by splitting the results according to the categories reveals interesting insights, as summarised by Table III. The first observation that can be made is that students pay more attention to their digital consumption than the two other categories. Also, people from the public at large category are less actively informing themselves about sustainable IT. Finally, students are all ready to completely or partially adapt their behaviour to decrease their negative impacts. Nearly half of the surveyed pupils only agree to consider a partial change, while the public at large category contains the largest number of reluctant persons.

TABLE III: Looking at the results of the survey by categories (secondary school pupils, higher education students and public at large) reveals some significant differences.

	Q1		Q2		Q3		
	Yes	No	Yes	No	Yes	No	Partly
Pupils	32%	68%	23%	77%	50%	5%	45%
Students	43%	57%	24%	76%	66%	0%	34%
Public	35%	65%	4%	96%	59%	7%	35%
Total	36%	64%	16%	84%	58%	4%	38%

Although the contestants are quite properly distributed in terms of category for the playoff round, mostly only higher education students showed up for the final. On the 23 finalists that took part, there were four pupils from secondary schools, fourteen students from higher education institutions and five persons from the public at large category.

B. Scores

The best contestant obtained 22 points for the playoff round, since he gave 14 correct answers, 3 wrong ones and one abstention. Table IV summarises the scores of the participants for the playoff round, and Figure 2 shows their distribution for the 135 contestants. Only 51 of them obtained a positive score,

while 70 got a negative one. Focusing solely on the number of correct answers, the contestants responded correctly to roughly a third of the questions, on average.

TABLE IV: The total scores obtained by the contestants for the playoff round range between -16 and 22 points.

	Min	Max	Mean	Stddev
Total score	-16	22	-1.1	6.1
Correct answers	0	14	6.3	2.4
Wrong answers	0	17	10.4	3.5
Abstentions	0	18	1.4	3.2

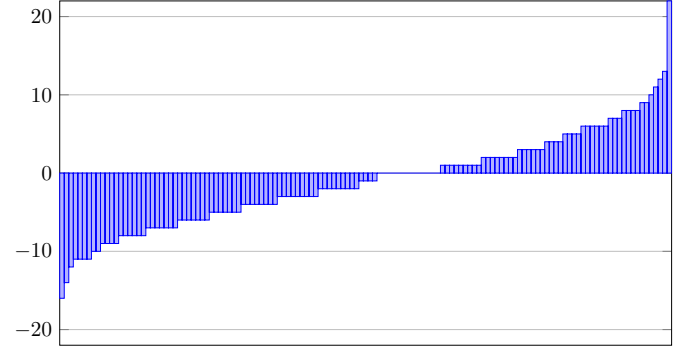


Fig. 2: Among the 135 contestants who took part in the playoff round, there are 51 who got a positive score, 70 a negative score and 14 just obtained 0.

TABLE V: Students have the best performance in terms of total number of points, while there are more people from the public at large category with positive scores.

	Total score				# contestants		
	Min	Max	Mean	Stddev	< 0	= 0	> 0
Pupils	-16	13	-2.0	6.3	28	4	14
Students	-14	22	-0.5	6.0	16	9	13
Public	-12	12	-0.7	5.9	26	1	24
Total	-16	22	-1.1	6.1	70	14	51

Analysing the total scores while taking into account the categories reveals insightful observations. Table V summarises

TABLE VI: The six best-answered questions all have at least half of the contestants who have selected the correct answer.

	Answer option A		Answer option B		Answer option C		Answer option D	
Q4: What proportion of e-mail sent world-wide each day is read?	40%	(35)	55%	(19)	60%	(9)	75%	(1)
Q12: What is the proportion of young Belgians who have already been victims of cyber-bullying?	one out of 2	(8)	one out of 3	(42)	one out of 5	(17)	one out of 12	(2)
Q15: What proportion of connected objects is recycled around the world?	0.5%	(5)	1%	(16)	5%	(29)	10%	(3)
Q22: What share does digital technologies play in global greenhouse gas emissions?	0.20%	(3)	1%	(5)	4%	(32)	10%	(13)
Q23: What benefits can be attributed to the (reasonable) practice of video games?	creativity	(2)	visual acuity	(5)	ability to concentrate and pay attention	(13)	all of the above	(32)
Q40: What percentage of the weight of office waste in France is consumable paper?	45%	(5)	60%	(3)	75%	(18)	80%	(3)

them with some indicators about their distribution. From these results, it appears that students better performed than contestants from the other two categories in terms of total score, but the public at large contains the most substantial proportion of positive ones.

C. Questions

To have some hints about the awareness level of the contestants regarding the impacts of digital technologies, the answer options they selected for the fifty questions of the dataset have been analysed. For 28 questions, the most selected option corresponds to the correct answer. Table VI shows the six best answered questions, that is with more than half correct answers. They are all easy ones, except the question number 40 that is a medium one. The same observation is made when splitting these results according to the categories, except for Q4 for which secondary school pupils equally selected the first and second answer options as the most selected one.

From the data shown on the table and the best-answered questions, it comes out that some of them are related to well-communicated figures in Belgium (Q12 and Q22). It seems reasonable to assume that most of the contestants have heard about the correct answer. For Q4, since everyone is flooded with many emails, picking the lowest ratio seems obvious.

IV. DISCUSSION

The results obtained from the analysis of data collected from the playoff round of the first edition of the proposed challenge are quite promising. First of all, from the survey, it seems that people are interested to adapt their behaviour to reduce their impacts due to their usage of digital technologies. One issue is that they usually do not pay attention to their digital consumption. Also, most of them also have never attended any event about these questions, this challenge therefore being the first one. This was quite surprising, since the organisers initially thought they would only attract people already interested in this field, to the challenge, which seemed to be not true for all participants.

Examining the answers to the questions, and the pretty low scores, it may be concluded that the current level of awareness of the impacts of digital technologies is quite low, as measured with the proposed quiz. This conclusion has to be taken with

a grain of salt since the kind of questions used is maybe not the most relevant one for the targeted public.

Another point worth mentioning is the notion of relative impact. In the proposed challenge, a few questions were about positive impacts of digital technologies. The challenge, as designed, may induce some binary views for or against the digital world. However, the balance between both positive and negative impacts should be taken into account for personal reflexions and to assess what behaviour changes are reasonable, for each individual.

V. CONCLUSION

To conclude, this work-in-progress paper presents a challenge that has been built to raise people's awareness level about the impacts of digital technologies on the environment, the climate, the health and the well-being. This challenge is a part of the larger DigiScope project and has been run for the first time in 2022. This paper reports on the results of this latter, to try understanding the current level of awareness and the willingness to know more about the impacts of digital technologies. The collected data shows that a broad view of the positive and negative impacts still lacks. Some figures are known, usually those advertised at large. The short survey conducted among the contestants shows that they are willing to know more on this topic and keen to adapt their habits to decrease the negative impacts.

Future work includes analysing the data collected from the second round of the challenge that took place in November 2022. It will also consider analysing how such a challenge contributes to the increase of the level of awareness about the impacts of digital technologies. Pre and post-challenge surveys will be designed for future editions of the challenge. Also, the target will be broadened to reach more people and not only those who already have an interest for the topic. Another idea on the table is the design of activities for teachers to use in their schools, combined with the challenge.

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